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## FISHERIES RESEARCH IN CANADA

By Dr. A. G. HUNTSMAN

UNIVERSITY OF TORONTO

IN fisheries research as in many other things Canada through her intermediate position is powerfully influenced by both Great Britain and the United States, but their differences have permitted her to "call her soul her own" and to follow a somewhat independent course. Her organization for fisheries research did not spring like Minerva "full-armored from the head of Jove," the creation of some master or collective mind, as have many research organizations, but has developed like an organism, in relation to its environment and by learning from experience.

After the forced union of Upper and Lower Canada (Ontario and Quebec) in 1841, the new Province of Canada felt the stimulus of opportunity for self-government. With demands for protection of its fishing population along the shores of the Gulf of St. Lawrence from inroads of fishermen from the colonies of New Brunswick and Nova Scotia and from the New England states, it considered the services of a British cruiser inadequate and in 1852 appointed Pierre Fortin, a graduate in medicine of McGill University and in later life a Member of Parliament, as magistrate in command of the expedition for the protection of the fisheries in the Gulf of St. Lawrence, building the armed schooner *La Canadienne* for his use. He was not only magistrate, but also counselor and physician to the scattered communities along the coast, and in addition initiated fisheries research. He described the fishes (naming a new species) as well as the fisheries, and developed a system of detailed fishery statistics that was adopted for the rest of Canada and that has given this country these basic data for fishery research, collected in more detail and continuously for a longer period than holds for any other country. On confederation of the province with New Brunswick and Nova Scotia to form the Dominion of Canada in

1867, a Department of Marine and Fisheries was formed and recently there has been a Department and a Minister of Fisheries to represent this relatively important field in the counsels of the Cabinet.

In spite of keen desire by those in authority for more knowledge, fisheries research did not develop in the uncongenial atmosphere of administration, where, under pressing need for immediate action, the best thinking ability that is available is preempted for making wise decision with the knowledge at hand. However, the department assisted the sponge specialist, J. F. Whiteaves, to dredge in the Gulf of St. Lawrence in the seventies, which resulted in his "Marine Invertebrates of Eastern Canada." Also it employed the naturalist and geologist, H. Y. Hind, to prepare its case before the Halifax Commission of 1877 in Canada's controversy with the United States over fishing rights, and he produced a noteworthy but little known presentation of available oceanographic knowledge of Canadian Atlantic waters on the causation of the fisheries.

Other forces were at work. Rapid increase in the population of the continent produced the illusion of diminishing natural resources, there being an actual decrease in the amount per person. This illusion was fortified (1) by the undoubted disappearance of certain animals, as in fisheries the early extermination of walrus in the Gulf of St. Lawrence, and (2) by emphasizing each drop in abundance of valuable species in long-term fluctuations of still unknown origin. This brought about the establishment of a federal fishery service in the United States with the appointment of Spencer Baird of the Smithsonian Institution as Commissioner of Fish and Fisheries in 1871. The largely illusory decrease of fishes was already being seen as having a remedy, which has proved equally illusory. Artificial hatching and planting of fry originated in Europe and developed simultaneously and rapidly in both Canada and the United States, giving extensive governmental fish cultural services and bringing into existence in 1870 what is now the American Fisheries Society.

It was, therefore, natural that Canada, in appointing a scientist as Commissioner of Fisheries in 1893, selected a specialist in fish embryology, E. E. Prince, a native of Leeds, England, who had a background of experience at the Gatty Marine Laboratory in Scotland under the zoologist, W. C. McIntosh, of St. Andrews University. The new appointee immediately advocated an idea already prevalent in Canadian academic circles that there should be a marine biological station for fishery research. The idea took definite shape at a meeting of the British Association for the Advancement of Science at Toronto in 1897, and with a grant from the Government the Marine Biological Station of Canada came into being in 1899 at St. Andrews, New Brunswick. Its board of management consisted of university representatives who wished summer facilities for themselves, their colleagues and their students to make contributions to knowledge that would be of value for the fisheries.

The station, with a movable laboratory, transported on a scow, tried in successive two-year periods five different sites along the coast, ending at Seven Islands on the north shore of the St. Lawrence but without the laboratory, which had suffered shipwreck. It was then permanently established in 1908 at St. Andrews as the Atlantic Biological Station. By this time there was on the Great Lakes the Georgian Bay Biological Station, established in 1901 under the curatorship of B. A. Bensley, of the University of Toronto, and, in British Columbia, the Pacific Biological Station, established near Nanaimo in 1907 under the curatorship of the Reverend G. W. Taylor, a retired Anglican clergyman, who had followed an English tradition of using leisure time to advance knowledge of systematic zoology.

The managing body was now a board of directors, of which one, the secretary, D. P. Penhallow, botanist of McGill University, directed the development of the new station at St. Andrews forcefully. But need for direction of work towards definite objectives conflicts with the freedom so necessary for the most fundamental research. After an enthusiastic start, the work quickly declined but was redeveloped with steady progress under curatorship. Under control of the board's finances by the department, a clerk's veto of a request for purchase of scientific literature because the latter was in foreign languages caused an explosion and resulted in the creation in 1912 by Act of Parliament of the Biological Board of Canada, an independent body under the minister to have charge of all biological stations.

Under the stimulus of the Great War, the secretary of the board, the biochemist, A. B. Macallum, of Toronto, fostered work at the St. Andrews Station, starting in 1915, on the biochemistry, bacteriology and handling of fresh and cured fish. As the first chairman of the Canadian Research Council, established in 1916, he favored the development of such work in a central institute under the council, the course taken in Great Britain. Then the Department of Fisheries, arguing that the board as a volunteer organization could not be expected to undertake all the necessary fisheries research, attempted in 1920 through parliamentary action to develop a scientific division for the purpose, which would have put fisheries research of all kinds under administration as it is in the United States. Macallum blocked this, but it cost him his membership on the board.

There have been full-time curators at both Atlantic and Pacific Stations from 1916 on and, on being made

directors in 1919, they were to an increasing extent active in developing the work. Attack on practical problems was encouraged by A. P. Knight, biologist of Queen's University, made chairman in 1920 and a member from the beginning, who had taken the first formal step toward creation of the board by a letter to the Royal Society of Canada in 1895. He had himself been studying pollution, bait, effectiveness of lobster culture and conditions in lobster factories in cooperation with the department. Inquiry in 1922 revealed that the fishing industry was for the most part untouched by what the board had done or even frankly sceptical of its having any value. In 1923, in order to bring the work definitely into relation with practice, non-scientists were brought into the board to represent administration and industry. Much more money was made available and new stations for the study of industrial problems in handling fish were shortly established on both east and west coasts. On careful consideration the first of these was established not at the center of government as in the United States nor at a foremost university research center as in Great Britain, but at Halifax, the most important center for the industry and with a university at hand. The second was established for political reasons at Prince Rupert, a remote fishing center, but has recently been transferred to Vancouver, which is comparable with Halifax.

The boom period of the twenties was gathering headway, with young men flocking into research as a profession and the public keyed up with great expectations. The chairmanship of the board went in 1925 to J. P. McMurrich, the anatomist, of Toronto, who as a young man trained under R. Ramsay Wright and enthused with the possibilities and need for biological research had publicly urged in 1884 such a development as was now in train. He had had a long experience in investigation at biological stations and universities in the United States, and he encouraged the directors of the four stations to develop the work. With departmental urging, the new experimental stations were quickly staffed with full-time investigators, and on the recommendation of a Royal Commission on Maritime Fisheries in 1928, this policy was extended to the biological stations. Annual expenditure, which had started at $2,000 in 1900 and had risen to over $46,000 by 1923, climbed rapidly to a peak of nearly $400,000 in 1930.

Then came the "depression," and in three years' time expenditures were cut by more than 50 per cent. With the board no longer dominated by men who wished to contribute personally to fisheries investigation and with increasing demands from the employed staff, financial support but not facilities available otherwise was withdrawn from volunteer workers from the universities.

The stations had grown in response to more or less local conditions rather than with central planning, but under the forceful chairmanship of the biochemist, A. T. Cameron, of Winnipeg, the organization was remodeled to achieve balance and smooth working, and so came to approximate the character of other research organizations. With centralization of direction and initiative, scientific output as judged by number and volume of publications dropped steadily in the face of increasing expenditure. In 1937, the Biological Board of Canada became the Fisheries Research Board of Canada, signalizing the change in forty years from a group of university investigators eager for facilities for personal investigation into a body of administrators, nine representing the most pertinent sciences in the universities, two the Department of Fisheries and four the fishing industry. This tripartite organization has permitted fusion of the varied points of view requisite for a successful policy of research toward fishery objectives.

In Ontario, the Great Lakes have offered a continuing challenge to biologists. R. Ramsay Wright on going from Glasgow to Toronto in 1874 responded to the challenge not only by training his budding investigators (including Macallum and McMurrich) on fresh-water material as in their combined work in monographing the catfish *Amiurus,* but by a lengthy report in 1892 upon the provincial fish and fisheries. He advocated a lake station which materialized on Georgian Bay under the board, but which languished and was abandoned in 1914. The board continued support of investigation of the Great Lakes until 1920, but, with Ontario then in control of its own fisheries, Bensley developed in 1924 the Ontario Fisheries Research Laboratory at the provincial University of Toronto, taking the smaller lakes for study as being more manageable and starting with Lake Nipigon.

First in 1920 did the board investigate lakes in the Prairie Provinces, namely, the interesting alkaline Quill lakes of Saskatchewan in which the stock of desirable fish comes and goes with long-period fluctuations in salinity. Steady investigation of the varied Prairie lakes began in 1925 with staff drawn from the University of Manitoba, and later augmented from the University of Saskatchewan; but, with these provinces assuming control of their natural resources, the work was discontinued after 1930.

An appeal for federal assistance to the Ontario Fisheries Research Laboratory led to the formation in 1936, under the auspices of the National Research Council and the Fisheries Research Board, of a National Committee on Fish Culture, which administers a grant to the council, by which aid has been given for work by university investigators on waters of the interior provinces. The aim of the committee is to survey and coordinate the whole field of fish culture

research. Of somewhat similar character and similarly sponsored are the Canadian Committee on Storage and Transport of Food, formed in 1938, and the Canadian Committee on Oceanography, formed in 1939.

The vast northern or Arctic part of Canada has been given but sporadic attention in keeping with its virtually uninhabitable character. Stefansson may maintain it to be a friendly country, but neither he nor any one else has pioneered its successful settlement with people of European stock. The prevalent idea, doubtless a European product, that northern waters teem with life has maintained great hopes for development of fisheries, particularly among the people of the Prairie Provinces in regard to the inland sea of Hudson Bay, 500 miles in diameter. The board sent investigators to the bay and strait in the twenties, and one went with a modern steam trawler, sent by the department in 1930 to make a thorough search for fish other than those in the tributary streams and close to shore. Not a single commercial fish was obtained. This agreed with the experience of the Hudson's Bay Company in the eighteenth century, which with experienced Spitzbergen fishermen obtained only three fish for an expenditure of £20,000. That all the water of the bay except a shallow surface layer in the summer was found to have a temperature below −1.8° C. explains not only its lack of commercial fish but also the high arctic character of its fauna. And yet it lies south of the latitude of Iceland, which has such notable fisheries.

To have more of the famous Malpeque oysters, particularly the "Curtain Island Cups," took the first station to that bay in Prince Edward Island in 1903 and 1904, with their life history to be elucidated. The mature English investigator (a member of the board), to whom had been assigned this phase of the work, lost caste by mistaking scale insects on planted brush for oyster spat and he complained later in *Nature* of the poor facilities for research. It was the "chore boy" of the station, Jos. Stafford, of Toronto and McGill Universities, who published ten years later a volume on "The Canadian Oyster, its Development, Environment and Culture." But the Malpeque oysters were almost exterminated in 1915 and 1916 by a disease, presumably introduced with seed oysters from Long Island Sound. When this was made a federal scientific and administrative problem, the board established in 1929 the Prince Edward Island Biological Station on the bay in charge of A. W. H. Needler. With scarcely any oysters left, it was possible to replace public fishing by private culture and with new methods the resistant stock that had developed in the inlets was extended to ever new areas. The industry grew so rapidly that in 1941 it was justifiable to issue a bulletin on "Oyster Farming in Eastern Canada."

Although producing more lobsters than any other country Canada had to have hatcheries, the first in 1891, but these failed to improve conditions. When shown by Knight to be worse than useless, they were abandoned in 1919. He tried out the rearing method of A. D. Mead, of Rhode Island, in 1914 and 1915 in the cold water of the Bay of Fundy with absolute failure and in 1916 in the warm water of Northumberland Strait with so little success that no further efforts have been made. Then the value of governmental hatching and planting of salmonids, which had been developed extensively in both the United States and Canada, but not in Great Britain, was brought into serious question by H. C. White's results in studying from 1923 to 1930 the fate of speckled trout fry planted in streams of Ontario and Prince Edward Island. A thorough test of the effectiveness of sockeye salmon culture was made by R. E. Foerster in a part of the Fraser River system, B. C., from 1925 to 1935, and it revealed results so incommensurate with cost that the artificial culture of sockeye salmon was abandoned by Canada in 1937.

These negative results leave open the question of what we should do to get more fish. Control of fish predators on sockeye salmon in British Columbia and of bird predators on Atlantic salmon in Nova Scotia has been not without promise, but the predation problem is a knotty one. Fish culture has been definitely successful for introductions into suitable barren waters. Starting from that solid fact, attempts are being made to develop effective regular use of the product of Atlantic salmon hatcheries for waters in which natural hatching is demonstrably unsuccessful or inadequate.

The United States, but not Canada, took membership for a time in the North European International Council for the Exploration of the Sea. In 1920, on the initiative of Canada, the North American Council on Fishery Investigations was formed in cooperation with the United States and Newfoundland. This has permitted Canadian fisheries research on the Atlantic to be closely stimulated by and coordinated with the investigations of the U. S. Bureau of Fisheries and the work of the Woods Hole Oceanographic Institution. Contacts were established with the European council, particularly through the fact that France, which belonged to that council, took membership in 1922 in the North American Council because of her fisheries on the Grand Banks.

The Passamaquoddy tidal power project at the boundary between the United States and Canada provided the council with a most difficult problem in fishery research. The St. Andrews Station, which had been studying the waters involved, believed that Canadian fear of serious injury to the local very concentrated "sardine" (small herring) fishery, largely Canadian, had some real basis, while the power project

made a great appeal to the imagination of New England, particularly with the domestic market for the sardines having been ruined by liquor prohibition, since they had been used to stimulate thirst. The council could not state what effect the project would have and the investigation, which it recommended, lasting over two years and carried out by scientists from four countries, failed to provide the basis for sure forecast of the effect. A revised plan, considered as not apt to cause serious damage to the fisheries, was started by the U. S. Government, but abandoned after $6,000,000 had been spent "before ascertaining if the plans were technically sound" as stated in SCIENCE (Vol. 83, p. 508) by President Compton, of the Massachusetts Institute of Technology, who supported the statement that this project "breaks all records in getting the least electricity for the money."

International cooperation in fisheries research has gone farthest on the Pacific coast. As a background, there has been the treaty of 1911 between the two countries for the preservation and utilization of the fur seals of the Pribilof Islands, which has worked so satisfactorily. In 1924, the North Pacific Halibut Treaty between the United States and Canada became effective, and the commission that was appointed under its provisions has had continuous scientific investigation of the halibut problem. Outstanding has been its thorough attempt to test the theory of overfishing by following carefully the result of definite restriction in the catch. A more economic condition has resulted, namely, an increased yield per unit of effort, whatever may be the effect on the stock, which is not yet clear. There has, however, been some failure to control the catch. A similar commission for the sockeye salmon of the Fraser River came into being in 1937, taking over the scientific investigations carried on by the Fisheries Research Board of Canada. It is a question, however, whether the principal matter, the bringing back of the large runs eliminated by a rock slide at Hell's Gate in 1913 blocking the ascent of the fish, is not already being remedied by nature.

Difficulty in handling "fish" is due largely to its very perishable nature. For example, smut or blackening in canned lobster was found by Andrew MacPhail of McGill in 1898 to be iron sulfide associated with bacterial decomposition and he advocated more thorough sterilization of the cans. Then F. C. Harrison, of MacDonald College, reinvestigated it (1923) and recommended chemical control by use of acid pickle in the cans, but G. B. Reed, of Queen's, was able to show (1924) that the important thing was to avoid decomposition before canning, which might be serious in four hours' time.

Smoked fish (finnan haddies and smoked fillets) presented the first problem for the Halifax Station, but the trouble was found to be merely failure in muggy weather to dry the outer part quickly enough into a shiny pellicle before it was acted upon by the smoke which prevents the sheen from developing, and the housewife wanted the sheen. The good effects of the smoke proved to be due largely to the contained formaldehyde, which, curiously enough, the "pure food" laws prohibit from use for preservation of food. Frozen fish has had a poor reputation, and Canadian frozen hake was the subject of strong official complaint from the troops in France in the Great War. Rapid freezing and steady cold storage were found to give a prime product and, as a demonstration, many tons of really fresh haddock fillets were sold in Toronto in the frozen state in 1929 as a high quality product at a price 50 per cent. above that of the "fresh" fish. The trade has, however, as yet been unable to ensure proper handling at all stages from the water to the consumer. The Halifax Station has shown that the fishy odor of "fresh" fish, which is absent from fish that are really fresh, is the result of the setting free in sea fish of trimethylamine from trimethylamine oxide by incipient decomposition. Really fresh fish, which are without the fishy odor both during cooking and eating, which leave no aftertaste, and which could be greatly relished by many people, particularly invalids, who now dislike fish, is as yet practically unobtainable, through failure of the trade to use sufficient care and speed in handling. Tests showed that the "fresh" fish sold in winter when preservation is easier actually contained more trimethylamine than it did in summer.

In contrast with fish handling, the crying need in connection with the actual fishing is not for the application of the knowledge we have but for more knowledge. Fishery regulation like fish culture is still based for the most part upon hope, not upon assurance of effectiveness. Real advance requires freedom of thought, which will come only by removing the incubus of the past—time-honored beliefs without proved basis. "Homing of salmon" is a belief that satisfies and removes incentive to discover how that fish moves in the sea and why. "Races" of fish have an extensive literature without any facts of breeding and have so often been shown to be environmental effects that there are serious proposals to remove from "race" any implication of heredity. "Depletion," except as an uneconomic condition which may exist when fishing starts, is little more than a bogie to frighten the credulous. That it is so seems to me to be evident from E. S. Russell's recent (1942) book "The Overfishing Problem" (based upon his lectures at the Johns Hopkins University, which were sponsored by the late Raymond Pearl), since it is stated that "there is more than a risk—there is a threat—of destruction of stocks." Those who raise this bogie to get definite action conveniently ignore incompatible

facts such as these: More herring (102,194,000 lbs.) were caught in the Canadian Passamaquoddy region (Bay of Fundy) in 1941 than ever before, although this region is fished more intensively than any other, with the chief incidence on the yearling fish less than half-way on the road to sexual maturity and with no protection for the spawners. Although Lake Erie is more intensively fished than any other of the Great Lakes, it yielded more whitefish in 1939 than is recorded for any earlier year and the Canadian catch (U. S. figures not available) was 45 per cent. higher in 1941 than in 1939. We have still much to learn.

# INTERNATIONALISM IN SCIENCE[1]

By Dr. KARL K. DARROW

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I HAVE been asked to speak on internationalism in science, or rather in the particular field of science which happens to be mine, the field of physics. The quickest way to handle this subject would be to reverse it, and speak of *nationalism* in science. This would be a conveniently narrow subject, for in science there is hardly any nationalism. The laws of nature are everywhere the same, and the ways of describing them do not differ from land to land. You may indeed remark that in different lands they are described in different languages. In so far as this is true it is not important, except as an inconvenience; and it is not even entirely true. The laws of nature are described by mathematics, and mathematics is a universal language. You can look at a book of physics in some language of which the very letters may be unfamiliar, and still you can tell what the author is treating by following the train of his equations. If you can read his words or get some one to translate them, you find that there is no imprint of nationality on his ideas, any more than on the laws which he happens to be describing.

So, the journals and the books of science are a cosmopolitan literature, and indeed the most cosmopolitan thing which now remains to us. In the happy days before the other war there were other cosmopolitan things: the gold standard, and the free circulation of art and of artists from country to country, and the worldwide diffusion of travel and trade with limitations so light that they now seem like freedom. These did not survive the other war, or survived it only in a crippled fashion; but the literature of science continued still to pass all boundaries even when its creators could not, a sort of intellectual gold standard by which the worth of every contribution and the standing of every contributor were appraised. Englishmen were not judged by Englishmen exclusively, nor Germans by Germans nor Americans by Americans; the common opinion of the scientific world was the court of first and last resort. No experiment was disregarded, no idea neglected because it came from the opposite side of a frontier. Few if any scientists strove to keep their ideas confined within their own countries. The notion of keeping a discovery undisclosed is repugnant, I can without exaggeration say it is revolting, to nearly every man of science. So few are the exceptions to this rule that we still look with wonder on Newton and on Cavendish, who were exceptions to it, and try to divine what peculiar quirk of personality made them such deviations from the norm. Nearly every one in science spoke to all who would listen, and nearly every one in the entire world of science was ready to listen to a new experiment or a new idea, from whatever part it came.

But even so, were there not some nations which were always the discoverers and the teachers, and others which were always the copyists and the learners? Nothing would seem more natural, and nothing could be further from the truth.

Take the four men whose consecutive labors enabled us to understand the motions of the heavenly bodies: Copernicus the Pole, Galileo the Italian, Kepler the German and Newton the Englishman. They were astronomers, but they were physicists also, for the laws of motion of the heavenly bodies are those of earthly bodies also, exemplified on a grander scale. Take the story of radioactivity. Radioactivity was discovered because x-rays had been discovered. The discoverer of x-rays was a German, but the man whom his work inspired was a Frenchman. Another Frenchman and his Polish wife carried on the study, and for a time it might have been thought that Paris was destined to be the center of all wisdom about radioactivity for ages to come. Not for a very long time, however! Not a decade had elapsed before every one who cared at all about this field was looking eagerly to England, and not because of an Englishman either, but because of a New Zealander whom a fellowship endowed in Britain had brought to Cambridge. The focal point of research in radioactivity traveled with this man to Montreal and then back again to England. It is Rutherford of whom I speak, the very man who later became the first of all men to achieve the transmutation of the elements. So long as he lived, the great Cavendish laboratory at Cambridge was the greatest scene of transmutation

[1] Broadcast, under the auspices of the American Philosophical Society, over Station WRUL on June 24.

in the world. Now the art and science of transmutation are dispersed throughout all countries; they are cultivated in America most of all, largely because Americans invented the two very ingenious devices which are used to produce the very high voltages demanded for transmutation. It was, however, an Italian who first taught the world to use the most variously efficient of all the agents of transmutation, the agent which we call "the slow neutron."

I could tell the same sort of story for almost every achievement in physics, and the lesson would always be the same. Progress in science depends on the spirit of the brilliant man; and in this case above all, the spirit bloweth where it listeth, heedless of national boundaries and heedless of racial groups. There has never been a city which was the capital of physics as Vienna for a century was the capital of music. There has never been a nation which was preeminent in physics as France so many years was preeminent in painting. Metaphorically speaking, if you walk through the galleries of physics you do not find the masterpieces labelled "French School" or "Dutch School" or "Italian School." There is just one school of physics, and from its inception it has been the school of all civilized nations.

Those of my listeners who heard the prior programs of this series are probably expecting something more. You may be waiting now to hear me tell of some great scheme or schemes of formal international cooperation, set up and going on for the benefit of physics. But those who speak for other sciences, astronomy for instance, can give you more striking examples than I can. I might indeed mention the laboratories built and the equipment given by the Rockefeller Foundation for physicists in certain European lands—laboratories now, by tragic irony of fate, ruined by civil war or taken over by the Nazis. It is allowable to hope that soon they may again be serving their intended purpose, and that the example of great donations by private wealth across frontiers may survive to be followed by future generations.

More significant as yet has been the living aid interchanged by the nations—I mean, the students who have gone from their homelands to some other country, not to sit at the feet of a famous master (as the saying used to be) but to stand beside him and work with him upon some problem of his own selection. Few of the leaders of physics have worked entirely by themselves. Normally, the brilliant physicist requires aid, and the skilled intelligent aid of men who are almost his peers, to follow out the ramifications of his thought and to perform the experiments suggested by his ideas. Mostly his fellow-countrymen supply the aid, but not by any means always. Many a Canadian and many an Australian has brought his stone or stones to the edifice reared by a British physicist; many an American has done the like for a German in the days before the other war and in the days of the Weimar republic; many a Chinese and many a Japanese has done it for an American. The graduate schools of many a university were microcosms of a non-embattled world, little groups composed of many strangers working together in a comity and with a mutual understanding such as we all should like to see realized in the world at large. We ought to try to increase their number after this war, and do away with certain formal restrictions which impeded them from arising in certain parts of the world. Yet if there had never been any such group, or if there were never to be any such group again—even in that deplorable and highly unlikely case, science would still be international. It would be inevitably international, so long as the books and the journals were allowed to cross the frontiers. Every physicist sooner or later, and glad or sorry as he may be, finds collaborators springing up all over the world. They are taught by his experiments and by his calculations, and he is taught by theirs. It could not be otherwise. Ideas flow about the world like the lifeblood in an organism. If from any part of an organism the flow of blood is withheld, that part decays. The same is true of the organism of science and of thought. If any one doubts this, let him look upon the demonstration which for the past ten years has been presented by the enemy.

# OBITUARY

## FRANK SCHLESINGER
### 1871–1943

THE death of Frank Schlesinger deprives American astronomy of its most distinguished authority upon precise astrometric measurement.

Born in New York, the son of Joseph and Mary Wagner Schlesinger, he received the degree of B.S. from the College of the City of New York at the age of nineteen. After five years' experience as a surveyor in his native city he studied for the doctorate at Columbia (Ph.D., 1898).

In the following year he began his astronomical career at the International Latitude Observatory at Ukiah, California, which he established, and operated for four years, as observer-in-charge. The visual observations demanded the highest attainable precision and care, and half of them had to be made in the morning hours. It was a severe introduction to astro-

metric work; but his enthusiasm for this somewhat austere type of investigation was life-long.

In 1903 he went to the Yerkes Observatory, where he spent two years in the photographic determination of stellar parallaxes, under the auspices of the Carnegie Institution. The precautions which were necessary to avoid systematic errors had been discussed theoretically by Kapteyn. Schlesinger's practical applications of these principles and his own ingenious inventions made his methods a standard which has been followed, with little change, in the thousands of determinations of trigonometric parallax made at many observatories ever since.

His most important personal contributions were the rotating sector, by which the image of a bright star is equalized with those of faint comparison stars, and the method of dependences, which greatly simplifies the reductions.

In 1905 he was appointed director of the Allegheny Observatory, and inaugurated an extensive program of observations for parallax with the 30-inch photographic refractor, and also researches on radial velocities and spectroscopic binaries.

The results of both were ably discussed. One example of his acumen may suffice. In all long series of observed stellar parallaxes, a few will come out negative—a geometrically impossible result, due to accumulation of observational errors. Most observers are irresistibly tempted to re-observe these stars, and the new series almost always give more reasonable values.

Schlesinger pointed out that this amounts to selecting for correction the cases in which the observational errors happen to combine in one direction, while ignoring those in which they had the opposite effect, so that the general mean of all the results would be systematically vitiated, and therefore resolutely avoided the practice.

He was called in 1920 to be director of the Yale University Observatory, where he remained for twenty-one years. Here he found an astrometric tradition which he continued, with increased equipment.

An observing station was established at Johannesburg, at which the parallaxes of hundreds of Southern stars were determined, and an extensive program of photographic observation of star-places inaugurated at New Haven. With the aid of specially designed lenses, the measurable area on a single plate was increased from about $5° \times 5°$ to $12° \times 15°$—with great saving in the number of specially observed reference stars required for a given zone of the heavens.

The reduction of these large plates demanded the inclusion of terms negligible on small ones; but Schlesinger's ingenuity reduced the total work of computation to a remarkably small total per star. His introductions to the volumes of the Yale Zone Catalogues afford by far the best text-book for the student of the subject.

Almost his last work was a general catalogue of stellar parallaxes, in which the results of all observers, after careful study of their accidental and systematic errors, are combined—a task demanding exceptional judgment.

In all this work he showed the same characteristics—unremitting industry; thorough knowledge of the problems to be investigated, the instruments for observation and the physical and mathematical principles involved in the reductions; remarkable ingenuity in devising improvements in both; a deep love of accuracy, which never tolerated defects; and a well-proportioned sense of scientific economics, which resulted in a remarkable volume of excellent work from the available equipment.

His work brought him many honors. He was a member of the American Philosophical Society, the American Academy of Arts and Sciences and the National Academy of Sciences; a foreign associate of the Royal Astronomical Society and the Royal Society of Science of Upsala; a correspondent of the French Academy of Sciences and the Bureau des Longitudes. He was president of the American Astronomical Society (1919–1922) and of the International Astronomical Union (1932–1935). He received the degree of Sc.D. from Pittsburgh in 1920 and Cambridge in 1925, the Valz Medal of the French Academy, the Gold Medal of the Royal Astronomical Society, the Bruce Medal of the Astronomical Society of the Pacific and many other distinctions.

Those who knew him will think most of all of the qualities which do not appear in this formal account—his cordial hospitality, his unfailing kindness and good humor and his invariable high ideals. He was the moving spirit of the "Neighbors"—the group of astronomers who, without any formal organization, derived great profit, as well as pleasure, from their meetings at New Haven.

His advice—by which the writer profited often—was valuable not only because of his full grasp of the scientific bearing of a situation, but even more for his sympathetic comprehension of the human problems involved and the high-minded lucidity of his appraisal of its ethical implications. He will be sorely missed by many friends.

He retired from his position at Yale in 1941. Failing strength had led to a gradual curtailment of his activities, which he accepted with quiet and cheerful philosophy during two years of retirement. Then his health failed, and the end came on July 10.

He was twice married, in 1900 to Eva Hirsch, of Ukiah, who died in 1928, and in 1929 to Mrs. Philip

W. Wilcox, of New York. His widow and one son by his first marriage survive him.

HENRY NORRIS RUSSELL

PRINCETON UNIVERSITY

## ARTHUR WILLIS GOODSPEED
### (1860–1943)

ON June 6, 1943, Arthur Willis Goodspeed, a pioneer in the study of x-rays, died at Concord, N. H., a few miles from the small town of Hopkinton where he had been born eighty-three years before. A descendant of early New England settlers, the son of Obed and Helen (Morse) Goodspeed, he passed his early years in Boston. Graduating from the Boston Latin School, he entered Harvard College. Here he came under the influence of John Trowbridge and Benjamin Peirce, who encouraged him to pursue the study of the physical sciences in which he had shown marked aptitude even as a boy. In 1884 he graduated from Harvard, winning high honors in physics and mathematics.

Immediately after graduation he was offered a position as assistant in physics at the University of Pennsylvania. As this provided an opportunity for advanced study, he accepted it, and this decision determined the scene of his life-work. He enrolled in the newly established graduate school of that university, and in 1889 received the degree of Ph.D., being, incidentally, the first recipient of a degree from that school.

At this time the chair of physics was held by George F. Barker, a scientist of international reputation. Goodspeed's association with this brilliant lecturer gave him invaluable experience and inspiration. He continued under Barker through the grades of instructor and assistant professor, succeeding him when he retired in 1900, and continuing as director of the laboratory until he himself reached the age limit in 1931. Thus, his teaching service of nearly half a century was wholly spent at this one institution.

The period of his service was one of rapid growth of the university and of the department of physics. He saw in his time its staff and its activities increase ten-fold. Much of the success of the many adjustments made necessary by this expansion was due to the administrative skill, ready decision and quiet tact which he exhibited.

As a lecturer he carried on the tradition of his predecessor in sparing no pains to devise ingenious and striking experiments with which to emphasize the essential aspects of his subject. Even after the pressure of administrative duties compelled him to give up much of his formal teaching he would frequently, in presenting new developments in physics, devote great care to illustrate them with clever and interesting demonstrations.

He was early attracted by the scientific aspects of photography—an interest which he retained throughout his life and which perhaps dated from the time when, as a young instructor, he witnessed and assisted at the famous experiments of Muybridge on animal locomotion. What wonder, then, that the report of Röntgen's discovery in 1896 strongly drew his attention and that he became one of the earliest investigators of the new rays? He at once recognized their importance from the medical point of view and, in collaboration with many physicians of the city, carried on numerous investigations on osseous malformations, the location of foreign bodies and similar topics. In this work he developed an experimental technique that was at that time unexcelled. Indeed, some of his plates taken then compare favorably with those of the present day.

His studies of the physical and therapeutic properties of the rays also were begun at this period and carried on for some years. He later investigated the properties of the secondary x-radiation. His work in the field of radiology was recognized by his election in 1902 as president of the American Röntgen Ray Society.

The increase of his official duties put a check to these investigations, though they were never wholly discontinued. The administration of the laboratory and service as chairman of important faculty committees demanded much of his attention. For some years he served on the board of managers of the Franklin Institute. In 1901 he was elected secretary of the American Philosophical Society. His faithful and efficient service in performing the duties of that responsible office will be remembered by many of its members. When he resigned the position in 1935 he was appointed editor of the society's publications and continued as such until a year before his death.

Goodspeed was married in 1896 to Annie H. Bailey, of Hyde Park, Mass. Their children were Frederick, who lost his life in a parachute accident in 1928, Willis and Helen (Mrs. John R. Skeen). In 1913 he married Ethel W. Mitchell, of Staunton, Va. Their son, Arthur, is at present Lieutenant in the armed services of the United States.

Though his professional life was passed in Philadelphia, Goodspeed always retained an affectionate attachment to his New England home. He usually spent his summers at Hopkinton and took part in many of its civic activities. And when his work was finished he returned to his native town to enjoy quietly the close of his life, which was to be so soon terminated.

Goodspeed always retained his sturdy New England characteristics. His thrift and skill in management served him well in the administration for many years of a department which never received adequate finan-

cial support. His relations with his associates were most cordial, and he was always solicitous for their interests. The writer will ever hold in memory with pleasure and gratitude the encouragement, advice and cooperation which he received during the many years of their association.

HORACE C. RICHARDS

## RECENT DEATHS

DR. ROBERT B. HINMAN, professor of animal husbandry at Cornell University, died in his fifty-fifth year on July 26.

EDWARD HALL BOWIE, regional director for the Pacific States of the United States Weather Bureau at San Francisco, president of the American Meteorological Society, died on June 29 at the age of sixty-nine years.

ALBERT KINGSBURY, founder and president of the Kingsbury Machine Works, Philadelphia, died on July 28 at the age of eighty years.

DR. ORVILLE HARRY BROWN, specialist in internal medicine, died on July 26 at the age of sixty-eight years. Recently he had been collaborating with Dr. John Lawrence, of the University of California at Berkeley, in experiments using cyclotrons to combat malignant growths.

THE death on July 28 at the age of sixty-one years is announced of Sir Harold Beckwith Whitehouse, gynecologist, president of the British Medical Association.

# SCIENTIFIC EVENTS

## THE DEATH-RATE IN GERMANY[1]

RECENTLY published statistics of mortality rates in German towns show that the health of the urban dweller has been steadily deteriorating, and this is especially marked during the later months of 1942. The following figures refer only to the large towns of "Greater Germany" with a total population of 24,500,000.

Compared with the corresponding months of 1941, infant mortality rose by 17 per cent. during the last quarter of 1942 to 69 per 1,000 live births. For the whole year the rate was 66, against 59 for 1941. This contrasts with a record low rate for England and Wales during 1942 of 49. Among children aged one to five—another sensitive index of health—the number of deaths rose sharply in 1942 to 7,236. In previous years the number had been 6,404 in 1941, 6,062 in 1940 and 5,670 in 1939.

School children aged five to 14 are also being affected, but adolescents seem to be affected more than any other group. For ages 15 to 20 a rise of 38 per cent. in 1942 was recorded over the number of deaths in 1939. The numbers were: 4,159 in 1942, 3,192 in 1941, 3,126 in 1940, and 3,023 in 1939. Contributing to these significant upward trends in mortality among children were sharp increases in the number of deaths from diphtheria and scarlet fever.

The report also shows a steeper rise in deaths from tuberculosis. There were, in German towns, nearly 5,500 more deaths from all forms of tuberculosis in 1942 than in 1939. The death-rate per 1,000 population at all ages was 24 per cent. higher in 1942 than in 1939, and the rise was more rapid in 1942 than in 1941.

The new statistics disclose a sharp rise in the number of suicides. In the last four years the numbers have been 7,647 in 1942, 6,222 in 1941, 6,104 in 1940 and 6,387 in 1939. It has been the experience of most belligerent countries in this and in past wars that the suicide rate declines during hostilities. This has happened in Britain during the present war, and in Germany the number fell in 1940. The last quarter of 1942 showed, however, a rise of 87 per cent. (to 2,538) over the number registered during the corresponding quarter of 1940 (1,358).

It does not appear that political murders or suicides in concentration camps are included in the official statistics; nor does it seem that suicides of imported workers are included.

All these death-rates for the large towns are likely to underestimate the actual rise in mortality. There are several reasons to support this view.

The evacuation of children, mothers and expectant women to rural areas might be expected to reduce the number of deaths in the towns.

As the official statistics relate only to civilian deaths, the transference of large numbers of adolescents into the armed forces would reduce the civilian population exposed to the risk of tuberculosis.

The removal of hospitals, institutions and sanatoria from the Ruhr and Rhineland towns to rural areas should reduce the number of urban deaths—unless the register of deaths is retained in the town records.

Turning from deaths to births, the latest figures show a dramatic fall in the birth-rate. For the large towns of Germany the number of births in 1942 declined by 80,000 from the figure of 419,000 for 1940. The rate per 1,000 total population was down to 13.9 in 1942 compared with 17.3 in 1940.

The last quarter of 1942 recorded a rate as low as 12.7. This experience for German towns is borne out

[1] From *The Times*, London.

by the rate for all areas of Greater Germany, which had declined from 20.4 in 1939–40 to 15.2 in 1942—a loss of approximately 550,000 live births.

## UNITED STATES LECTURERS IN BRAZIL

ADVANCED practices in the application of the science of metallurgy in the United States will be made available to Brazilian scientists and industrialists during the coming year through a technical educational project established at the Escola Politecnica of the University of São Paulo, one of the leading engineering schools of Brazil. Four distinguished United States scientific men have been appointed to give lectures on fundamental metallurgy over a period of a year, each to remain in residence there for three months during the extent of his lecture series. The project is being jointly financed through the office of Nelson A. Rockefeller, coordinator of Inter-American Affairs, and the Escola Politecnica. It is administered by the Stevens Institute of Technology under a contract with the coordinator's office.

The first lecturer, Dr. A. Allan Bates, manager of the chemical and metallurgical department of the Research Laboratories of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., is already *en route* to Brazil and was expected to be at the University of São Paulo by July 29.

He will be followed by Dr. Robert F. Mehl, professor and head of the department of metallurgical engineering and director of the Metals Research Laboratory of the Carnegie Institute of Technology, Pittsburgh; Professor Arthur Phillips, of the Hammond Metallurgical Laboratory, Yale University, and Professor Gregory Jamieson Comstock, director of the powder metallurgy laboratory of the Stevens Institute of Technology.

Laboratory facilities for metallurgical work are available at the Instituto de Pesquisas Tecnologicas, which is connected with the Escola Politecnica. Modern research and production equipment is provided by electric arc melting furnaces, induction furnace, small rolling mill, cupola furnace and complete microscopic and metallographic apparatus. It is the desire of the Escola Politecnica to inaugurate a complete series of courses in fundamental and advanced metallurgy.

The project was initiated when the Brazilian institution asked the help of the coordinator of Inter-American Affairs in obtaining the teaching services of four professors of metallurgy. The coordinator's office solicited the advice and counsel of the engineering division of the Board of Economic Warfare, now the Office of Economic Warfare.

The problem was assigned to Professor Comstock, of the Stevens Institute of Technology, who is a technical consultant for the division and who suggested the plan which was adopted. The institute accepted the responsibility for administering and supervising the program. The lecturers were appointed by the trustees with the consent and cooperation of their own institutions or industrial employers.

The subject to be taught, fundamental metallurgy on a graduate level, will be presented in four divisions by the lecturers, each of whom is regarded as preeminent in his particular field. Dr. Bates will lecture from the viewpoint of industrial research and development; Dr. Mehl on the physical metallurgy of iron and steel; Professor Phillips on non-ferrous metallurgy, and Professor Comstock on powder metallurgy. They also will assist the university authorities to develop a curriculum in metallurgical engineering.

## THE PROPOSED OCEANARIUM AT CONEY ISLAND

TENTATIVE plans for the proposed post-war Aquarium or Oceanarium to be built at Coney Island at an estimated cost of $1,500,000 are described in *The New York Times*. It will take the place of the old Aquarium at Battery Park, and will extend nearly ten acres between the Boardwalk and Surf Avenue, from West Fifth to West Eighth Streets. The site is virtually already owned by the city.

*The Times* states that in addition to a modern main marine building housing fresh and salt-water species from every part of the globe and outdoor pools for seals, penguins and cormorants, it is planned to construct a children's aquarium. As shown in a tentative sketch, this will be a building resembling an old schooner, anchored in a pond off the main building.

Observation cat-walks will be constructed around the huge tanks and through them. In the latter the observer would find himself literally "inside" the tank, encased in a glass passageway with water under, around and above him.

There will be, according to present plans, exhibits of tropical, temperate, Arctic and biological specimens, a separate section for aquatic birds and waterfowl, a promenade deck, lecture hall and restaurants. An over-pass will lead directly to a special subway entrance and a parking lot will be constructed to accommodate 450 automobiles.

The Finance Committee of the City Council has unanimously approved an amendment to the capital budget for 1943 to include the sum of $42,000 for preliminary plans and study of the oceanarium. It is expected that the New York Zoological Society will contribute an additional $20,000 toward the cost of preliminary planning.

## STUDY OF GERMICIDES AND BACTERICIDES AT THE OHIO STATE UNIVERSITY

AN intensive investigation of germicides and bactericides, including anti-malarials, has been undertaken by the Research Foundation of the Ohio State University, of which Dr. A. R. Olpin is director. This has been made possible through a grant of $23,000 by the William S. Merrell Company, pharmaceutical manufacturers of Cincinnati.

The grant takes the form of the establishment of three annual post-doctorate and three annual graduate fellowships in bacteriology and chemistry. Members of the regular university staff who will also contribute to these studies are Dr. J. M. Birkeland, Dr. G. L. Stahly and Professor A. R. Winter, all of the department of bacteriology, and Dr. W. R. Brode and Dr. W. G. France, of the department of chemistry.

Investigations of anti-malarials to be conducted at the university will be correlated with the work going on in many other laboratories throughout the nation. An investigation of penicillin, the new and very potent germicide or bactericide derived from mold, is planned. This work is part of a larger program of research coordinated by the Committee on Medical Research in Washington. The new projects are the outgrowth of a number of years of friendly cooperative relations between the foundation and the Merrell Company.

Many valuable and practical discoveries have been made through these researches, including a promising new method of synthesizing menthol. This is especially important at the present time as the supply of menthol from the Far East has been virtually cut off by the war.

## WORK OF THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

BASIL O'CONNOR, president of the National Foundation for Infantile Paralysis, announces that three records in the 1943 infantile paralysis fund-raising appeal—in the amount raised, in the number of contributors and in conducting the appeal at a lower expense than any previous campaign—exceed all previous results by more than 30 per cent.

Net collections amounted to $5,527,590. This is $1,500,000 higher than any previous year. Expenses were $147,871, or only 2.6 per cent. of collections. Mr. O'Connor estimated that there were more than 35,000,000 contributors.

The Motion Picture Theaters Drive, headed by Nicholas M. Schenck, president of Loew's, Inc., and Harry Brandt, president of the Brandt Theaters, raised $2,086,596. The National March of Dimes to the White House amounted to $570,000.

Half the funds collected go to the National Foundation for the broad front attack on the disease, including research work, education and epidemic aid, while the other 50 per cent. remains with local chapters of the foundation covering practically all the nation's 3,070 counties where it is used for local relief for victims of infantile paralysis, regardless of age, race, creed or color.

Mr. O'Connor stated that this country may face a severe test this year in coping with infantile paralysis due to a marked increase in the number of cases during the first six months. He said that "as of to-day, more cases have occurred in 1943 than for a comparable period during the past nine years, the number being double that of last year at this time. So far the epidemic has appeared in California, Texas and Oklahoma. First, southern California was involved. Then the epidemic spread to the San Francisco Bay area. Now there is some increase in Washington. In a similar way the epidemic has spread northward, with the advancing season, from Texas into Oklahoma. At this time Kansas shows an increase." Dr. John L. Lavan, assistant medical director of the National Foundation, with equipment and a staff of workers, has been sent to the areas affected.

## THE LIBRARY OF SIR ISAAC NEWTON

ACCORDING to *The Times*, London, the Pilgrim Trust has bought from Messrs. Henry Sotheran, Limited, a collection of 858 books which once belonged to Sir Isaac Newton. The trustees also bought from the same firm Newton's copy of the Old Testament in Greek and his copy of Isaac Barrow's edition of Euclid's Elements. They have decided to offer all the books they have acquired to Trinity College, Cambridge, and the master has expressed the readiness of the college most gratefully to accept the gift.

Charles II made Barrow Master of Trinity and during his short tenure of the post he founded the magnificent college library. Before this dignity had been conferred on him, Barrow, the divine, had declared that he could not make a bible out of his Euclid, or a pulpit out of his mathematical chair, and in 1669 he resigned the Lucasian professorship of mathematics in favor of his still more distinguished pupil, Isaac Newton. Eighty-three of the books show actual marks of Newton's handwriting, of which twenty have his autograph signature. Four of these are of special interest, as they bear the date of 1661, the year in which Newton entered Trinity College. Newton represented the university as a Whig in the Convention Parliament of 1691.

# SCIENTIFIC NOTES AND NEWS

As noted in SCIENCE last week, Dr. George D. Birkhoff, Perkins professor of mathematics at Harvard University, has been elected an honorary fellow of the Royal Society of Edinburgh. Other Americans elected to honorary fellowships were Dr. H. S. Gasser, director of the Rockefeller Institute for Medical Research; Dr. Herbert S. Jennings, Walters professor of zoology, emeritus, of the Johns Hopkins University, and Dr. Oswald Veblen, professor of mathematics at the Institute for Advanced Study at Princeton, N. J.

SIR HENRY HALLETT DALE, president of the Royal Society, London, a member of the Scientific Advisory Committee of the British Cabinet, was presented on July 8 with the Harben Gold Medal of the Royal Institute of Public Health. The Smith Award was presented to Dr. James Fenton, medical officer of health for Kensington. Former recipients of the Harben Medal include Pasteur, Lister, Koch, Metchnikoff, Gorgas, Baron Kitazato, Sir Ronald Ross and Sir Leonard Hill.

DR. JOHN J. GREBE, director of the Physical Research Laboratory of the Dow Chemical Company, Midland, Mich., will be presented with the Medal of the Society of Chemical Industry for 1943 at a meeting in November of the American Section in New York.

KANSAS STATE COLLEGE recently conferred the honorary doctorate of science on Dr. P. J. Parrott, formerly director of the New York Agricultural Experiment Station at Geneva.

*Nature* states that the University of Aberdeen has conferred the honorary degree of LL.D. on Dr. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy, University College, London. The degree of D.Sc. has been awarded to W. Burns for a thesis on "An Oscillographic Study of the Activity in Nerves Associated with the Viscera"; and on Dr. R. D. Stuart, for a thesis on "A Study of Leptospirosis in the South-West of Scotland with Special Reference to Laboratory Investigation, Epidemiology and Specific Prophylaxis."

THE Council of the Royal College of Surgeons of England has conferred honorary fellowship on the Right Honorable Winston Churchill, Prime Minister, First Lord of the Treasury and Minister of Defense.

DR. EDWARD FRANKLAND ARMSTRONG has been elected president of the Royal Society of Arts, London.

THE retirement on July 1 is announced of Dr. E. M. Freeman, dean of the College of Agriculture, Forestry and Home Economics of the University of Minnesota. He is succeeded by Dr. Henry P. Schmitz, professor and chief of the Division of Forestry.

DR. CHARLES C. ADAMS, since 1926 director of the New York State Museum, retired on July 31, having reached the statutory age of seventy years.

THE title of professor emeritus of the history of medicine in the University of London has been conferred on Dr. Charles Singer on his retirement from the professorship of the history of medicine at University College.

PROFESSOR WILLIAM I. MYERS, head of the department of agricultural economics, a former governor of the Farm Credit Administration, has been appointed acting dean of the New York State College of Agriculture at Cornell University, filling the vacancy caused by the death of Dr. Carl E. Ladd.

PROFESSOR GEORGE D. SCARSETH, of Purdue University, has been appointed head of the department of agronomy. He succeeds Professor A. T. Wiancko, who had served since 1903 as professor of agronomy and head of the department.

DR. RUSSELL A. RUNNELLS, associate professor of pathology in the Division of Veterinary Medicine of Iowa State College, has resigned to become head of the department of anatomy in the Division of Veterinary Science of the Michigan State College, East Lansing.

DR. RALPH G. SMITH, of the Medical School of the University of Michigan, has been appointed to succeed Dr. Erwin E. Nelson as professor of pharmacology and head of the department of pharmacology of Tulane University.

DR. ANTHONY A. PEARSON, assistant professor of anatomy at the Loyola University School of Medicine, Chicago, has become associate professor of anatomy at the College of Medicine of Baylor University at Houston, Texas.

DR. LESLIE L. LUMSDEN, of New Orleans, medical director of the U. S. Public Health Service, retired, has become lecturer in epidemiology at the Medical Branch at Galveston of the University of Texas.

*Chemical and Engineering News* states that Roy Erwin Swift, formerly instructor of metallurgy in the School of Mines, University of Alaska, has been appointed associate professor of chemistry at the university. The School of Mines has been discontinued for the duration of the war, but the first two years of the basic engineering sciences are to be continued.

DR. EDWARD B. MATHEWS has retired as head of the Maryland Geological Survey. Dr. Joseph T. Singe-

wald, Jr., has been appointed his successor as director of the Department of Geology, Mines and Water Resources.

DR. WILLIAM E. MARTIN has resigned as associate horticulturist in the Arizona Agricultural Experiment Station to become senior agriculturist with the Office of Foreign Agricultural Relations in Peru of the U. S. Department of Agriculture.

DR. L. GRANT HECTOR, chief engineer with the National Union Radio Engineering Company of Newark, N. J., has been appointed production consultant of the War Production Board. He will advise on miniature tubes in the radio division to increase production and improve quality through the coordinated efforts of the manufacturers.

GEORGE W. BURPEE, a director of the American Society of Civil Engineers, a past president of the American Institute of Consulting Engineers, a partner in the engineering firm of Coverdale and Colpitts, has been elected president of the General Aniline and Film Corporation to succeed Robert E. McConnell, who has resigned.

DR. ERNEST W. LANDEN, research physicist with the Armour Research Foundation, Chicago, has become research engineer with the Caterpillar Tractor Company, Peoria, Ill. He will continue studies on Diesel combustion.

DR. MARY LOUISE QUAIFE, assistant in the department of physiology of the University of Illinois, has become research biochemist at Distillation Products, Inc., Rochester, N. Y.

DURING the summer Professors Edward D. Allen and Albert G. Hart, of the department of economics of Iowa State College, are engaged in tax research for the Treasury Department at Washington.

THE annual meeting of the Corporation of the Marine Biological Laboratory will be held in the auditorium of the laboratory at Woods Hole, Mass., on Tuesday, August 10, at 11:30 A.M., for the election of officers and trustees and the transaction of such business as may come before the meeting.

THE Alabama legislature at its recent session made an annual appropriation of $100,000 to the State University for research purposes. This was in addition to the usual maintenance and building grants.

THE Alabama Research Institute, recently organized by a group of Alabama business men, is setting up research fellowships in the state university and state colleges.

THE Winthrop Chemical Company has announced plans for a large increase in the production of penicillin. Additional facilities for its manufacture have been acquired in Rensselaer, N. Y., and according to Dr. Theodore C. Klumpp, president of the company, will be devoted entirely to the manufacture of the drug which is now allocated exclusively to the armed forces. Penicillin is now under direct allocation of the War Production Board for national defense and there is no prospect that a surplus will soon be available for civilian use.

THE *Journal* of the American Dental Association announces that the United States Department of State, in a letter from Secretary Cordell Hull to Daniel F. Lynch, chairman, has commended the work of the Pan-American Relations Committee of the American Dental Association, stating that "it is contributing in no small measure to that international understanding which is fundamental to world peace." The Pan-American Committee, in conjunction with the Department of State and the W. K. Kellogg Foundation, is sponsoring the Inter-American Postgraduate Course in Dentistry, which opened at the University of Michigan on August 2.

THE *Journal* also announces that certain changes have been made in the dental program at Harvard University now being carried forward by the new School of Dental Medicine, including reduction of the course from five years, as set in 1940, to four academic years or three calendar years under the accelerated wartime schedule; award of the D.M.D. degree only on the completion of the course, and the permission of students successfully completing the course for the D.M.D. to register subsequently in the medical school and qualify for the M.D. degree on the completion of one and a half additional academic years or one additional calendar year in the medical school. When the activities of the Harvard School of Dental Medicine were planned with funds of $1,350,000 in July, 1940, a five-year course was established, at the end of which the successful student was given both the M.D. and the D.M.D. degree. According to an official statement by President James B. Conant, it was predicted from the start that difficulty would be encountered under the plan because a man enrolled for the joint degrees might shift his interest to some other branch of medicine rather than to continue with the course for the D.M.D. degree. Dr. Conant said: "The prediction of difficulty was accurate. Whether or not this would have been the case except for the war, no one can tell. Instead of the course of five academic years we planned, Army and Navy regulations now make mandatory the limitation to three calendar years in courses leading to the medical and the dental degree."

*The Times*, London, reports on July 10 that the Combined Food Board has made arrangements for an

investigation to be made into available statistical records and other data concerning food supplies and consumption in the United States of America, the United Kingdom and Canada. Three United States officials have arrived in England to confer with officials of the Ministry of Food. They are Dr. John M. Cassels, Dr. Montell Ogden and Dr. L. A. Maynard, all of the U. S. Department of Agriculture. The Canadian Government is also participating in this inquiry. Ian Mcarthur, of the Canadian Dominion Bureau of Statistics, has also arrived in England. Personal discussions will supplement the full exchange of information on food matters which is already taking place through the established channels of the Combined Food Board.

*Chemical and Engineering News* reports that the embargo placed on the export of scientific periodicals by the United States is proving a heavy blow to Swedish investigators. Several prominent research workers in the April 7 *Stockholm's-Tidningen* express serious concern over their inability to keep abreast of scientific progress and new discoveries made in the United States. Professor Arne Tiselius, of the University of Uppsala, is quoted as saying, "It is vital for Swedish science to maintain contact with American research." Since the United States entered the war no scientific literature, with but few exceptions, has entered Sweden. A list of a hundred indispensable periodicals is being compiled and will be submitted to the authorities with an appeal that steps be taken for them to be regularly sent to Sweden. The *News* further reports that Swedish-British scientific cooperation has been made possible through an offer by the British Council to underwrite the printing in English of such Swedish doctors' theses as are of interest to the English-speaking scientific world. This offer, much appreciated in Swedish scientific circles, has been submitted to all universities and colleges in Sweden.

THE British Medical Research Council has arranged with the London Hospital for the establishment there of a department for research in industrial medicine. Dr. Donald Hunter, physician to the hospital, has accepted a part-time appointment to the staff of the council as physician-in-charge of the department, and the council has appointed Dr. Kenneth Perry and Dr. Norman Spoor as full-time research assistants to work under his direction. The hospital is providing accommodation and facilities, and will be responsible for the treatment of cases under investigation. The primary purpose of the department is to undertake clinical researches into disorders affecting industrial workers, including both occupational diseases and others of a more general kind. This work will be done mainly in the department itself, but the staff will make visits from time to time to other parts of the country where special problems for investigation may be brought to the notice of the council. The department will also be responsible for teaching and instruction in the subject. This arrangement supersedes that made last year for the appointment of a whole-time director of research in industrial medicine attached to the council's headquarters. The post had become vacant through the appointment of Professor A. W. M. Ellis to the regius chair of medicine at the University of Oxford.

IT is reported that an institute for typhus research has been opened at Lemburg. It has been named after Emil von Behring.

# DISCUSSION

## THE DIGESTION OF LIVING TISSUES BY PROTEOLYTIC ENZYMES[1]

THE insusceptibility of living bacteria, yeast cells, etc., to digestion by proteolytic enzymes has intrigued many investigators and a number of explanations for this resistance have been suggested.[2] Whatever the nature of this insusceptibility it is of a type which is easily lost. On death or injury a change occurs (protein denaturation?), which permits digestion to take place. In striking contrast to the resistance of these living forms is the susceptibility to digestion which mammalian tissues exhibit.[3] The present observations appear to suggest an explanation for the ability of proteolytic enzymes to digest living mammalian tissues in spite of the strong probability that these tissues possess the same protoplasmic and cellular characteristics upon which the insusceptibility to digestion of the freely living forms depends.

Trypsin has been shown to be capable of liberating histamine from mammalian tissues. This has been demonstrated for the perfused lungs of guinea pigs,[4] for the blood cells of rabbits[5] and for the liver of dogs.[6] Some recent observations with the trypan blue

[1] This research has been aided by a grant from the Clara A. Abbott Fund of Northwestern University.

[2] J. H. Northrop, "Crystalline Enzymes." New York: Columbia University Press. 1939.

[3] L. R. Dragstedt, *Arch. Surg.*, 44: 438, 1942.

[4] M. Rocha e Silva, *Arquivos d. Inst. Biol.*, 10: 93, 1939.

[5] C. A. Dragstedt and M. Rocha e Silva, *Proc. Soc. Exp. Biol. and Med.*, 47: 420, 1941.

[6] M. D. Ramirez de Arellano, A. H. Lawton and C. A. Dragstedt, *Proc. Soc. Exp. Biol. and Med.*, 43: 360, 1940.

test in rabbits indicate that the ability of trypsin, when injected intracutaneously, to cause a localization of the intravenously injected dye at the injection site, probably depends upon a local liberation of histamine from the skin and the consequent increased capillary permeability which this agent causes.[7] While observing these trypan blue reactions it was noted that adequate concentrations of trypsin digested the skin at the injection site, but that a marked dye localization always preceded the digestion. Also, it was found that weak concentrations of enzyme could produce definite localization of dye without subsequent digestion. These observations suggest that the local liberation of histamine is primary to, and possibly essential for, the ensuing digestion. To test this hypothesis, it was found that the concomitant injection of histamine with trypsin increased the amount of local digestion produced by the latter and would enable otherwise ineffective concentrations of enzyme to produce digestion. The histamine concentrations used did not cause any necrosis when injected alone.

The vitality of organized tissue is closely dependent upon the integrity of its vascular supply. Histamine is a potent angiotoxic agent, producing both marked contraction of arterioles and marked dilatation with increased permeability of capillaries. Thus trypsin releases an agent capable of embarrassing the vitality of tissues which depend upon a vascular supply. Its ability to digest organized tissue would appear to be conditioned by its ability to produce initially a sufficient degree of tissue injury to cause the cells to lose their specific insusceptibility to digestion. Free living cells (bacteria, etc.) are not injured by histamine (even if it is released from them) because its cytotoxic action is weak and there is no vascular system through which injury can be produced indirectly. Thus, while these observations do not explain the nature of the insusceptibility of living cells to tryptic digestion, they suggest an explanation for the ability of trypsin to digest organized tissue which obviates the alternative necessity of assuming that there is a fundamental difference in the protoplasm of the two types of tissues.

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## VITAMIN C IN EVERGREEN-TREE NEEDLES

IN his special report to SCIENCE[1] on the work of Soviet botanists, B. Shishkin says, in part, "Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. Biochemists in Moscow and Leningrad have organized mass production of vitamin C concentrate from pine needles. Despite the fact that the percentage of vitamin contained in needles is very small, this source of vitamin C is of particular value to us on account of the huge pine forests throughout the whole territory of the Soviet Union. . . ."

This report reminded me of the following account by Parkman in his book, "Pioneers of France in the New World":[2] "A malignant scurvy broke out among them. Man after man went down before the hideous disease, till twenty-five were dead, and only three or four were left in health. . . . Cartier, walking one day near the river, met an Indian, who not long before had been prostrate like many of his fellows with the scurvy, but who now, to all appearance, was in high health and spirits. What agency had wrought this marvellous recovery? According to the Indian, it was a certain evergreen, called by him *ameda*, of which a decoction of the leaves was sovereign against the disease. The experiment was tried. The sick men drank copiously of the healing draught,—so copiously indeed that in six days they drank a tree as large as a French oak. Thus vigorously assailed, the distemper relaxed its hold, and health and hope began to revisit the hapless company." Parkman gives the opinion in a footnote that "The wonderful tree seems to have been a spruce."

MAURICE DONNELLY
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## TRANSLITERATION OF RUSSIAN NAMES

THE recent communications of Knight[1] and Hrdlička[2] contained pertinent comments on the problem of representing Russian names and titles in American journals. It was a surprise to me, however, that neither referred to the Library of Congress catalogue rules for transliteration. As American scientists are becoming increasingly familiar with Slavic literature it would seem worth while calling attention to this method of transliteration with one or two comments on its use.

It has been my experience in studying translations, maps, gazeteers and catalogues of Russian work that a number of different systems are used which vary more or less from one another. The principal cause of transliteration confusion (particularly on maps and in library catalogues) is the fact that every one uses a different method. The worst system now in use would be the best one if it was employed by every one; *e.g.*, the Russian Я (pronounced *ja*, like

[7] M. Rocha e Silva and C. A. Dragstedt, *Jour. Pharm. and Exp. Therap.*, 73: 405, 1941.

[1] SCIENCE, April 16, 1943, pp. 354–355.

[2] Francis Parkman, "Pioneers of France in the New World," 17th ed., pp. 194–195. Boston: Little, Brown and Company, 1880.

[1] SCIENCE, April 30, 1943.

[2] SCIENCE, March 12, 1943.

the German "yes") is currently transliterated by any of the following letters and combinations according to the phonetic interpretation of the transliterator: ia, ya, j, ja or a. Possibilities for confusion are obvious. One need only reflect that a name beginning with this letter may be placed in four different positions in a Roman alphabet index. Although Russian orthography is highly phonetic (in contrast to the English), there are some cases of variability in the pronunciation of letters. This also results in various transliterations and consequent confusion in the index.

The Library of Congress employs a system which I do not like as a student of language but have adopted for practical purposes in my scientific studies. This system provides us with an equivalent for every Russian letter. As there are more letters in the Russian alphabet than in the current American alphabet, some diacritical signs and vowel and consonant combinations are used in conjunction with our own 26 letters. Although *approximate* phonetic rendering is obtained, the rules provide for use of the same equivalent *invariably* regardless of pronunciation. This is an essential regulation for maintaining so-to-speak "index integrity." Although one does sacrifice some phonetic value in strict adherence to the Library of Congress rules, it is the most nearly standard system, and in the interests of uniformity I urge its adoption by scientists dealing with Slavic literature. A diagrammatic résumé is on file in libraries and may also be obtained from Washington, D. C.

D. G. NICHOLS

GARDEN CITY, NEW YORK

IN SCIENCE for March 12 (p. 243) Dr. Hrdlička commented on the unfortunate lack of uniformity in transliterations of Russian names. He was justified in his criticism, which is supported by Dunlap in SCIENCE for April 30. The same name ending in "v" I have sometimes found transliterated in various publications four different ways, *i.e.*, "v", "w", "f" and "ff". Uniformity could be secured easily if the rules of the American Library Association were followed by at least all American writers. I have found a 3×5 inch library card published by the Library of Congress and carrying this system, most convenient in checking my memory of the transliterations.

The ligatured diphthongs used in this system involve a difficulty in publication, as these characters are not included in the equipment of any presses known to me, which use monotype machines. By omitting the arc which is used as a ligature, this trouble can be avoided. I have done this with a note stating the policy, and I know of at least two American presses which are following this practice.

R. M. STRONG

# SCIENTIFIC BOOKS

## MATHEMATICS

*Basic Mathematics for Pilots and Flight Crews.* By C. V. NEWSOM and HAROLD D. LARSEN, University of New Mexico. vi + 153 pp. New York: Prentice-Hall, Inc. 1943. $1.50.

THIS is a brief presentation of those parts of geometry, algebra and numerical trigonometry needed by members of the air force. The authors have kept in mind the recommendations of the Civil Aeronautics Administration, as well as the specific weaknesses in mathematics found by air force instructors. A review of arithmetic is included, and such topics as graphs, scales and measurement and vector diagrams are stressed. The principles of straight and circular slide rules are explained. There are a large number of practical problems, most of which will directly appeal to the student as related to aeronautics. The book seems well suited for use as a textbook for pre-flight preparation at the high-school level either in the classroom or through home study.

*Analytic Geometry.* By EDWARD S. SMITH, MEYER SALKOVER and HOWARD K. JUSTICE. University of Cincinnati. xii + 298 pp. New York: John Wiley and Sons, Inc. 1943. $2.50.

THIS text gives an extended treatment of plane analytic geometry, including chapters on higher plane curves, polar coordinates, parametric equations and empirical equations, followed by a brief treatment of solid analytic geometry. A short chapter on plane sections of a right circular cone, in which the fundamental properties usually taken as definitions are geometrically derived, precedes the discussion of the different types of conics. In this chapter, as well as in those on solid geometry, the figures are not only mathematically correct, but carefully designed to suggest the proper spatial relations. The authors have shown good mathematical judgment in avoiding incorrect statements, and sound pedagogical judgment in their selection of topics and omission of certain fine points. For some complicated proofs the student is referred to an outline in an exercise. The book covers competently the content of the conventional freshman course in analytic geometry, including ample material for the ablest students, and compares favorably with existing text-books in this field.

*Differential Equations.* By HARRY W. REDDICK, the Cooper Union School of Engineering. ix + 245 pp. New York: John Wiley and Sons, Inc. 1943. $2.50.

BESIDES most of the standard methods of solving ordinary differential equations, this text includes a chapter on power series solutions. Many of the worked problems and numerous exercises deal with physical and engineering applications, including full numerical data. The explanations are given in more detail than is often the case. The author's interest in technical applications leads him to discuss linear equations with constant coefficients immediately after equations of the first order, and to omit envelope problems and singular solutions. The book is suitable for the peacetime undergraduate course in differential equations, and just now may prove useful in some of the army training courses which devote a few weeks to differential equations and their technical applications.

*Plane and Spherical Trigonometry with Four-place Tables.* By WILLIAM C. BRENKE, University of Nebraska. x + 269 pp. New York: The Dryden Press. 1943. $1.90.

THIS revision of an earlier text-book includes all the traditional contents of courses in plane and spherical trigonometry with applications to surveying and navigation, as well as several additional topics. Thus there is a chapter on vectors and one on the mil and its use in artillery problems. A three-place table of functions of angles in mils is given. The four-place tables include a table of haversines, as well as those usually given. Computation by logarithms is explained in an appendix, but there is no reference to use of the slide rule. The treatment throughout is clear and comprehensive. The book should prove useful as a text in many of the courses now taken by civilians or service men.

PHILIP FRANKLIN

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## PHOTOGRAPHIC REPRODUCTION

*Principles of Photographic Reproduction.* By CARL W. MILLER. New York: The Macmillan Company. xii + 353 pp. 132 figs. 1942. $4.50.

"PROBABLY no one will read this book who has not spent many hours with photographic manipulation and who does not covet the opportunity to spend many more."

Thus, in the preface, does Dr. Miller warn that his book is not one for the beginner in photography. On the other hand, this does not mean that the book throughout is highly technical and abstruse—understandable only to those who have spent years in photographic research.

Among men of science, there are many to whom photography is a hobby as well as a useful tool. To them the general processes of exposure, development and printing, both by projection and contact, are entirely familiar, but perhaps some of the more advanced methods are mysteries. To such persons, who would naturally want a work thoroughly scientific in its treatment, Dr. Miller's book should be most welcome.

The arrangement of the book is a logical one. There are three main parts; the first on drawing, the second on gradations, the third on color. The part on "Drawing," concerned with the way in which the image of the scene or object is produced, starts with the lens itself. Then come chapters on the size, location and brightness of the image, on supplementary lenses, perspective, depth of focus and the arrangement of subject material. The latter is an excellent simple account of the basic principles of composition, a subject with which the scientist-photographer might be least familiar.

The camera obscura yielded images long before there was any photography. The image must be perpetuated, and that is the subject of part two—"Gradations." After chapters on exposure and development, the print is discussed. The limitations of chloride and bromide printing papers lead naturally to means for individual control and then to such processes of the expert as platinotype and palladiotype, carbon, oil, gum, carbro and bromoil. The final chapter of this section is concerned with the preparation of transparencies and lantern slides, with which beautiful naturalness can be secured.

The third and last part deals with color—first the problems of representing color in monochrome, then of reproducing color itself, both by additive and subtractive methods. In the chapter on subtractive color photography, "because of the greater economy of thought in visualizing color processes and the ease with which essential calculations can be carried through," the matrix algebra is introduced. Enough explanation is given to acquaint the reader possessed of some mathematical background with its use.

Methods of making three-color separation negatives and of printing them, multilayer films (*e.g.*, Kodachrome and Agfacolor) and the use of masking and other refinements in the precision reproduction of color occupy most of the concluding chapters.

In case the book is to be used as a text in a course in advanced photography, a number of problems are contained in the appendix. These will also be useful for the person using it in self-study, particularly as the answers are given. Four-place logarithms and anti-logarithms are included as well as a table of weights and measures, references to the literature

and a complete index. At the end of each chapter where photographic processes are discussed there is a formulary, giving the recipes for the various developers, toners, intensifiers, bleachers, etc.

Finally, the illustrations should be commended. Many of these clearly show the techniques described in the text. Scattered throughout there are also a number of beautifully reproduced examples of the photographic art, some in color. Since these are not credited to any photographer, they are presumably the work of the author himself. As such they demonstrate that he can apply these methods as skillfully as he can write about them.

JAMES STOKLEY

# THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

## RESOLUTION OF THE COUNCIL ON THE SCIENCE MOBILIZATION BILL (S.702)

THERE is now pending in the United States Senate the Kilgore Bill (S.702), entitled "A bill to mobilize the scientific and technical resources of the Nation, to establish an Office of Scientific and Technical Mobilization, and for other purposes." This pending bill is so sweeping in character and will affect science and scientists in so many ways that it merits careful consideration by the American Association for the Advancement of Science, the most broadly representative scientific organization in the United States. In examining the purposes and provisions of Bill S.702 it will be convenient to follow the 12 sections into which it is divided, and to point out which of the provisions are to be effective in time of peace as well as in time of war.

*Section 1* recites, first, the reasons for the bill, effective both in time of war and in time of peace. In enumerating the "serious impediments" to the "full development and application of the Nation's scientific and technical resources," the bill uses such terms as "unassembled and uncoordinated state of information," "unplanned and improvident training, development, and use, of scientific and technical personnel . . .," "delay and ineffectiveness in meeting urgent scientific and technical problems. . . ."

As to information about scientists, it is always available in the membership lists of scientific societies in every special field to a total of more than 500,000 names, in the membership list of the American Association for the Advancement of Science (25,000), in "American Men of Science" (28,000) and in the National Roster of Scientific and Specialized Personnel (500,000). As to information about scientific work, scores of scientific journals covering together every important field of science are published regularly in the United States. Moreover, abstracts and reviews of practically all the current literature of the world are available in a number of such publications as *Biological Abstracts* and *Chemical Abstracts,* each of which publishes about 25,000 abstracts annually.

As to "delay and ineffectiveness in meeting urgent scientific and technical problems," in 1863, at the instance of scientists of the United States, the National Academy of Sciences was established by an act of Congress which provided that the academy shall, without conpensation, advise the Government on scientific questions, an obligation that the academy has unfailingly fulfilled. The first world war began in August, 1914. Although President Wilson enjoined the citizens of the United States to remain strictly neutral in thoughts as well as in acts, in May, 1915, leading scientists of the country, realizing the nature of the storm in Europe, began to organize the scientists of the nation for service to the Government on a more comprehensive scale than could be provided under the limited membership of the academy. In March, 1916, a year before this country entered the war, President Wilson established the National Research Council by Executive Order as an agency of the National Academy of Sciences. It promptly effected an organization and prepared to respond to any calls the Government might make on scientists. The contributions of the National Research Council to the war in 1917–18 and to the national welfare during all the intervening years to the present have been enormous. It is now serving the Government through about 200 committees composed of more than 1,000 scientists. On June 28, 1941, President Roosevelt established by Executive Order the Office of Scientific Research and Development, completely under the administration of scientists. It has formulated plans for research on war problems and entered into contracts with university, research organizations and industrial laboratories which have entailed an expenditure of $188,000,000, all on a non-profit basis. The products resulting from these researches have been ordered through regular governmental channels under contracts amounting to $2,000,000,000. All this has been accomplished without discord, reorganization or the necessity of executive intervention. In addition to these activities, the principal scientific societies have appointed special committees for the investigation of war and defense problems in their respective fields and through which governmental agencies at any time can promptly obtain scientific information and competent personnel. In the face of such achieve-

ments the words "delay and ineffectiveness in meeting urgent scientific and technical problems" in Section 1 of S.702 are not appropriate.

*Section 1* contains also a declaration of policy, using such terms as "appraise," "mobilize," "assemble," "coordinate," "promote," "aid," "encourage," "discover and develop substitutes," "promote interest in scientific and technical education," "provide guidance," "standardize" and "establish a national scientific and technical office." These words express worthy objectives. But these objectives have already been realized by science and technology to such an amazing degree that within a century living conditions have been more completely changed than in the preceding thousand years.

*Section 2* defines terms used in the act. "Scientific and technical facilities shall include all real and personal property, . . . programs, projects, . . . methods, processes, procedures, . . . patents, inventions, . . . information or knowledge of every description used or intended to be used for scientific or technical purposes in research and development or in the production or supply of war or civilian goods or services." "Scientific and technical personnel shall include all persons, excepting physicians and dentists, who have completed any course of study in any college or university in any branch of science or its practical application or who have had not less than an aggregate of six months' training or employment in any scientific or technical vocation." "Agency or establishment" means any Federal or State agency or other body or any "local government, person, firm, or partnership engaged in business for profit, or any corporation, profit or nonprofit, association, school, college, and university." In short, "scientific and technical facilities," as used in S.702, includes every means useful in any way for the production of "war or civilian goods or services"; "scientific and technical personnel" includes every person, except physicians and dentists, who has completed a college course in any branch of science or who has been employed for six months on any kind of work that may be called technical; and "agency or establishment" includes every agency, corporation, person, partnership, association, school, college and university, whether or not organized for profit and whatever its purposes or activities may be. It would be difficult to make more inclusive definitions. Moreover, in giving to an agency under the President powers over broadly general things the act violates the spirit of the Federal Constitution which grants powers over specific things to the Federal Government and declares that those not so delegated nor prohibited by it to the States "are reserved respectively, to the States or the people."

*Section 3* defines the organization of the "Office of Scientific and Technical Mobilization." It is to be under the direction of an "Administrator" appointed by the President to serve at the pleasure of the President, and of a salaried "National Scientific and Technical Board," also appointed by the President, but whose duties are to be defined by the Administrator. This Board is to consist of six members, besides the Administrator, one to represent industry, one to represent agriculture, one to represent labor, one to represent the consuming public and "two additional members at large who shall be scientists or technologists." By previous definition in the bill, to be classed as a scientist or a technologist it is sufficient to "have had not less than an aggregate of six months' training or employment in any scientific or technical vocation." The Administrator will appoint all other employees, and he may waive the provisions of the civil-service laws and regulations if he determines it is necessary to do so.

Provision is made also for a non-salaried "National Scientific and Technical Committee," consisting of the Board previously mentioned, a representative from each of such Federal departments as the President shall designate, four additional representatives of the consuming public, six additional members representing labor, six representing management (including small business) and three additional scientists or technologists. That is, the Technical Committee will consist of twenty-five to thirty members, of whom five must be scientists or technologists in the sense that each of them shall "have had not less than an aggregate of six months' training or employment in any scientific or technical vocation." This committee is to be appointed by the President to advise and consult with the Administrator at least once a month upon basic policies of the Board.

In order that it might reasonably be hoped that any considerable fraction of the purposes of the act, as set forth in the latter part of Section 1, might be realized it would be necessary that the Administrator and the Board be men of the highest integrity, ability, experience in science and devotion to public welfare. Instead of insuring that the Board shall have these essential qualities the act provides for a primarily political Board of seven members, only five of whom need be scientists or technologists even in the extraordinary sense in which the term "scientific and technical personnel" is defined in Section 2.

*Section 4* defines the powers of the proposed Office, effective in times of peace and of war. Blanket authority is given for many purposes, including the powers to formulate, finance, control, contract for and operate all undertakings or projects that the Administrator shall determine fall under the broadly inclusive definitions of "scientific and technical facilities," "scientific and technical personnel" and "agency or establishment" previously given. This section

explicitly provides that these sweeping powers are to be exercised in accordance with rules and regulations prescribed by the Administrator and that they "shall have the force and effect of law" of Congress. That is, in passing this act the Congress would delegate to the Administrator appointed by the President law-making powers, relative to this subject, that are vested, in general, in the Congress by the Constitution of the United States.

*Section 5* transfers to the Administrator, by amending the Selective Training and Service Act of 1940, control over the deferment from military service of persons who, under the definitions of the act, are classed as "scientific and technical personnel." In view of the inclusive definition of "scientific and technical personnel," this provision would seriously impair the functioning of the already complex manpower control machinery.

*Section 6* gives the Administrator, in time of war, the right to requisition, subject only to review by the President, the stupendous means of production that, under the act, are classified as "scientific and technical facilities," and to represent before the War Production Board "any application for allocation of, and priority for, any critical material and equipment in scientific and technical research and development." The exercise of such a power would severely handicap the functioning of such efficiently managed and highly successful agencies as the Office of Scientific Research and Development, referred to in comments on Section 1.

*Section 7*, "any provision of law to the contrary notwithstanding," vests the Office with "the exclusive right to use, and with the exclusive right to license others to use, (1) any invention, discovery, patent or patent right which has heretofore resulted, or shall hereafter result, from research or invention for the carrying on of which the United States or any department, agency or establishment thereof either has heretofore contributed at any time since the declaration of national emergency on May 27, 1941, or shall hereafter contribute any money, credit, physical facilities or personnel; and (2) any invention, discovery, patent, or patent right which is at the time of the enactment of this act, or shall hereafter become, to any extent the property of the United States or of any department, agency or establishment thereof." These broad powers are vested in the Office however small the contribution by the Government or a governmental agency may have been. The Administrator is "authorized and directed to prescribe and promulgate rules and regulations which shall thereupon have the force and effect of law for the enforcement of the provisions of this section, . . ." This delegation of power giving the Office the exclusive right to use patents and to license others to use them opens the door to abuse in time of peace and adds nothing to the powers of the Government in time of war.

*Section 8* gives the Administrator the power to require all information he may desire "concerning scientific and technical facilities during the existence of a state of war and concerning scientific and technical personnel at all times." "Any person or establishment [possibly a university] refusing or wilfully failing to furnish the . . . shall, upon conviction thereof, be fined not more than $5,000 or imprisoned for not more than one year, or both."

*Section 9* authorizes the appropriation of $200,000,000 to carry out the provisions and purposes of the act. This section also authorizes the Administrator to organize corporations and to make loans to, or purchase all or part of the capital stock of, corporations whenever he deems it necessary to do so for the more effective exercise and performance of his own powers and duties or of those of the Office. The appropriation provided would be wholly inadequate for the purposes set forth.

*Section 10* gives the Administrator important powers usually lodged in courts, and it provides that "any person who wilfully violates any order, rule or regulation promulgated by the Administrator under the authority of this act shall, upon conviction thereof, be fined not more than $5,000 or imprisoned for not more than one year, or both." In giving the Administrator, a representative of the President, quasi-judicial powers the act departs from the distribution of legislative, executive and judicial powers as defined in the Constitution of the United States.

*Section 11* requires the Administrator to render annually to the President and to Congress a written report, summarizing the activities of the Office and the status and progress of science affecting the public interest.

*Section 12* provides that if any clause, sentence or paragraph of the act is invalidated by any court action it shall not affect the validity of the remainder of the act.

After careful consideration of the purposes and provisions of the Science Mobilization Bill (S.702), the American Association for the Advancement of Science, an organization having nearly 25,000 members (and having 187 associated and affiliated societies with a combined membership of over 500,000 persons whose interests cover broadly all the natural and social sciences) now, through its Council of about 250 members chosen from among the leaders of American science, respectfully recommends to the Senate and to the House of Representatives of the United States that the Kilgore Bill (S.702) be not passed either in its present form or in any other form containing similar provisions.

# SPECIAL ARTICLES

## ENHANCEMENT OF LEUKEMOGENIC ACTION OF METHYLCHOLANTHRENE BY PRE-IRRADIATION WITH X-RAYS[1]

LEUKEMOGENIC agents to which man is exposed are numerous, and it is of great interest to find out if one such agent can prepare the soil for or enhance the action of another.

X-rays are mildly leukemogenic.[2, 3] Moderate and large doses rapidly destroy blood-forming organs, but if x-ray action is discontinued, regeneration follows within a few days, and during this phase mitotic figures are seen in abundance in sections of blood-forming organs. It seems probable that during this phase blood-forming organs would be particularly susceptible to leukemogenic irritants.

To test this possibility, thirty-six mice of four to six weeks of age were irradiated with 175 r over the entire body. These mice were painted with methylcholanthrene, beginning the day following the irradiation. The technic of irradiation of treatment with methylcholanthrene has been described.[4] In addition, thirty-seven mice were painted but not irradiated, and eighteen mice were irradiated but not painted. The results are given in Table 1.

The figures indicate that pre-irradiation greatly enhances the susceptibility of mice to the leukemogenic action of methylcholanthrene. In addition, pre-irradiation hastens the onset of leukemia, as shown in Fig. 1.

According to more extensive, earlier work,[5] spontaneous leukemia occurs in about 11.6 per cent. of this genetically uniform stock (Rf/Ak), but the onset of illness is seldom if ever noted before the age of seven months. Preceding the current experiments the incidence of leukemia was again determined in both irradiated and non-irradiated mice of this stock (Table 2).

In this test the incidence of spontaneous leukemia in the stock used (Rf/Ak) was even slightly lower than noted before, but that among the x-rayed mice was fairly high. However, in this experiment 300 r of x-rays were used, while in that recorded in Table 1, 175 r were used. Moreover, the disease in these mice occurred at a later period than in those exposed to methylcholanthrene. The two control mice died of leukemia at twenty-one months of age, one of the x-rayed mice at five, the others at eight to seventeen months of age.

TABLE 1

INCIDENCE OF LEUKEMIA IN MICE TREATED WITH METHYLCHOLANTHRENE OR X-RAYS OR BOTH

| Treatment of mice | Experiment 1 | | | Experiment 2 | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. used | No. + | No. alive at 10–16 mo. | No. used | No. + | No. alive at 10–16 mo. | No. used | No. + | Per cent. + | No. alive at 10–16 mo. |
| X-ray, 175 r | 18 | 1 | 16 | .. | .. | .. | 18 | 1 | 6 | 16 |
| Painting with methylcholanthrene | 21 | 5 | 7 | 16 | 1 | 7 | 37 | 6 | 16 | 14 |
| X-ray and painting with methylcholanthrene | 19 | 11 | 5 | 17 | 12 | 5 | 36 | 23 | 64 | 10 |

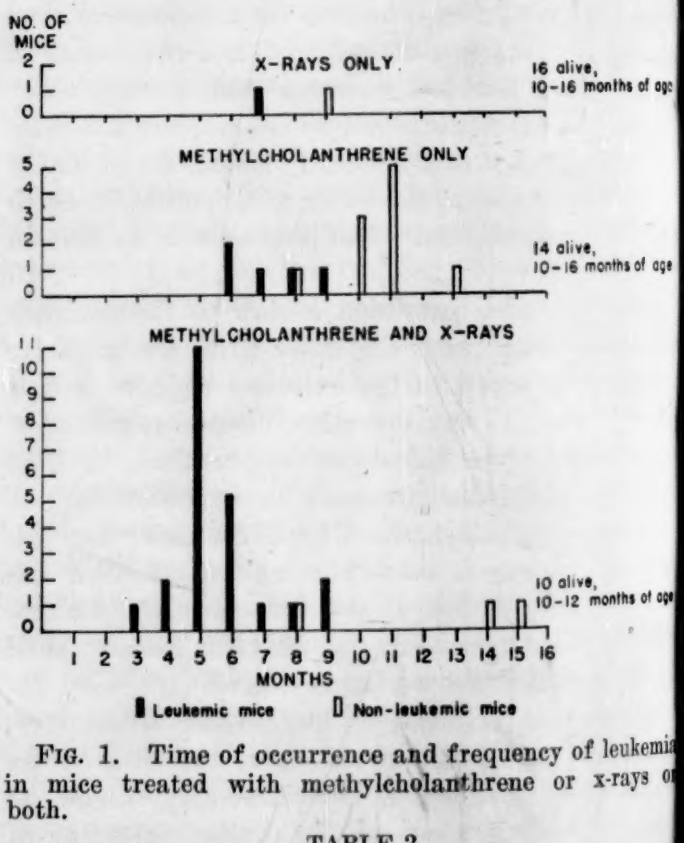


FIG. 1. Time of occurrence and frequency of leukemia in mice treated with methylcholanthrene or x-rays or both.

TABLE 2

| | No. in group | No. + | Per cent. + |
|---|---|---|---|
| Irradiated mice (300 r) .. | 17 | 10 | 59 |
| Non-irradiated control .... | 25 | 2 | 8 |

These findings can be explained in several ways. According to the supposition that seems most probable, the neo-plastic transformation of lymphoid cells is brought about by methylcholanthrene, while the derangement that follows irradiation prepares (sensitizes) them for the action of methylcholanthrene.

[1] This study has been supported by the Jane Coffin Childs Memorial Fund for Medical Research, the International Cancer Research Foundation, the Lady Tata Memorial Trust and the Anna Fuller Fund.

[2] C. Krebs, H. C. Rask-Nielsen and A. Wagner, *Acta Radiol. Suppl.*, 10: 1, 1930.

[3] J. Furth and O. B. Furth, *Am. Jour. Cancer*, 28: 54, 1936.

[4] D. P. McEndy, M. C. Boon and J. Furth, *Jour. Nat. Cancer Inst.*, 3: 227, 1942.

[5] R. K. Cole and J. Furth, *Cancer Res.*, 1: 957, 1941.

Results similar to those described above have already been noted in experimental studies on the production of skin tumors. Mottram[6] found that painting mice with 3:4 benzpyrene and irradiating them on the sixtieth day with a dose of 176 to 1,584 r gamma radiation produced both benign and malignant tumors of the skin. No tumors followed painting for the same period without irradiation. Similar results were obtained by Mayneord and Parsons[7] by the combined application of x-rays and a different carcinogen. They observed that irradiated and painted mice developed sarcomas at an earlier date and in greater numbers than the non-irradiated mice. Gilmour[8] obtained similar results by the combined application of estrone and 3:4 benzpyrene. The follicular sex hormone alone did not produce cutaneous tumors.

These observations indicate that subthreshold doses of different carcinogens may summate, or that one may sensitize tissues for the action of the other. The essential similarity of leukemia and accepted types of cancers is again emphasized by these experiments. The same agents differently spaced and dosed may produce either predominantly leukemia or the more accepted types of cancers. The mechanism of summation of carcinogenic stimuli deserves further experimental study.

## CONCLUSION

Both x-rays and methylcholanthrene are leukemogenic. The leukemogenic action of small doses of methylcholanthrene is greatly enhanced by pre-irradiation with doses of x-rays which alone rarely produce leukemia. The leukemogenic action of x-rays is milder than that of methylcholanthrene and affects a smaller number of mice after a longer period of latency.

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## THE COMPARATIVE NUTRITIVE VALUE OF BUTTER AND SOME VEGETABLE FATS[1]

IT has been generally accepted by nutritionists that, aside from differences in vitamin potencies, all fats have essentially the same nutritive value. An exception to this is the specific rôle played by those fats which contain certain unsaturated fatty acids.[2] Schantz *et al.*[3] have recently postulated that butter is more effective than vegetable oils in producing growth in weanling rats presumably due to long chain saturated fatty acids, although in a recent report the superiority of butter over corn oil was observed only when the dietary carbohydrate was lactose while conditions were reversed when carbohydrates other than lactose constituted the carbohydrate portion of the diet.[4]

We have followed the rate of growth of 21-day weanling rats for six or 12 weeks on diets composed of 68 per cent. of mineralized skim milk powder and 32 per cent. of the fat under study with supplements of vitamins A (as carotene and A), D and E added to the fats. Corn, cottonseed, olive, peanut and soybean oils were tested as well as butter and vegetable margarine fat. In one series where vegetable margarine fat and butter fat only were compared over a six-week period no differences in growth rate were noted. A total of 46 male rats and 89 female rats were used in these tests. In series II, where groups of approximately 15 male and 15 female rats were fed for 12 weeks diets containing each of the seven fats listed above, no differences were found in the growth at three or six weeks or with the males at 12 weeks. The female rats receiving the butter diet weighed slightly more at 12 weeks, but the difference was not significant statistically. However, in series III where diacetyl was added to the vegetable fats in an amount of 4 parts per million, no differences of weight were noted at any interval either in the males or females. The same number of rats was used as in series II. Not only was the growth rate identical as demonstrated by body weight but bone growth was also equal as found by x-ray measurements of tibia length at the end of three and six weeks on the respective diets. Also no significant differences were obtained in the water, protin, lipid, ash and calcium content of the rats which had received the various diets for 12 weeks. This would prove that the equal growth was actually due to similar tissue growth.

One explanation for the discrepancies between our results and some of those where *ad lib.* feeding is employed[3] is in all probability to be traced to the fact that weanling rats prefer a butter flavor and will eat more of such a diet. In experiments where the rats had a choice of a diet containing margarine fat or peanut oil with or without diacetyl, the rats ate more of the diacetyl-containing diets 18 times and of the unflavored diets in only one instance. Also in tests on twelve weanling rats carried out over 12 weeks, where both an unflavored peanut oil diet and one containing commercial butter flavor[5] were offered the rats, a decided preference was invariably shown for the

[6] J. C. Mottram, *Am. Jour. Cancer*, 30: 746, 1937.
[7] W. V. Mayneord, L. D. Parsons, *Jour. Path. and Bact.*, 45: 35, 1937.
[8] M. D. Gilmour, *Jour. Path. and Bact.*, 45: 179, 1937.
[1] This work was carried out under a research grant from The Best Foods, Inc.
[2] G. O. Burr and M. M. Burr, *Jour. Biol. Chem.*, 82: 345, 1929; 86: 618, 1930.
[3] E. J. Schantz, C. A. Elvehjem and E. B. Hart, *Jour. Dairy Sci.*, 23: 181, 1940.
[4] R. K. Boutwell, R. P. Geyer, C. A. Elvehjem and E. B. Hart, *Jour. Dairy Sci.*, 26: 429, 1943.
[5] Verley "B F A."

flavored diet by eight of the rats, while almost equal quantities of the two diets were consumed by the other four rats. In no single case is there any evidence of a preference for the unflavored diet.

These experiments indicate that on an adequate vitamin intake the fats studied are of equal nutritional value for growing rats. They explain how the greater growth of weanling rats on a butter diet in experiments where *ad lib.* feeding is employed may result simply from a greater food consumption due to the preference of rats for butter flavor. Diets containing all these fats were used with equal efficiency in transformation to body tissue.

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# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## A SIMPLE AND EFFICIENT CALOMEL HALF CELL

SOME fifteen years ago a co-worker was told to prepare a calomel half cell using a glass filter tube on the

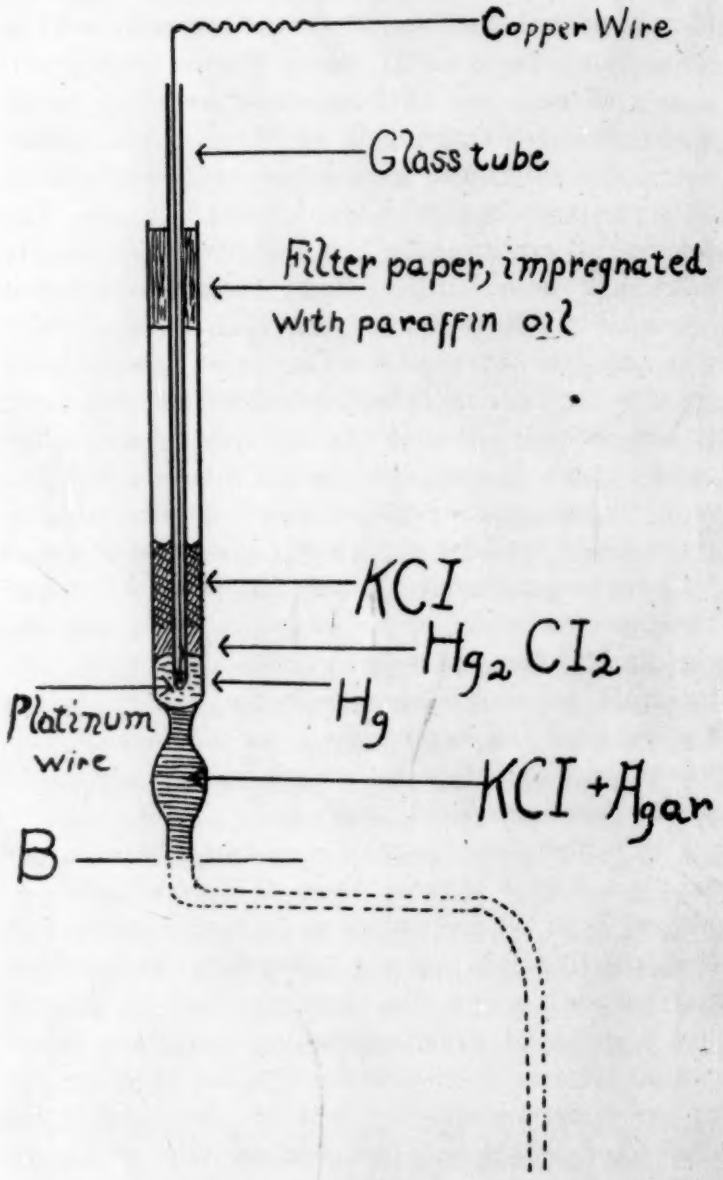


FIG. 1

end of the siphon connecting the cell and the analysis vessel. He covered the glass filter plate with the mercury, added the calomel and the KCl solution and inserted this electrode directly into the analysis vessel. Evidently, as he stated afterwards, he had suffered from temporary absence of mind, for that electrode could not be expected to work. But the half cell too was absent-minded: it worked. The thin moisture layer on the glass surface was sufficient to form a conductive bridge between the calomel-KCl suspension above the mercury and the filter plate below it.

I remembered this fact later when needing a standard half cell, but lacked the usual implements to construct it and had not the possibility of acquiring them. Here it is (see Fig. 1); it needs only 0.5 ml of mercury, works perfectly and may be useful in teaching and research laboratories. The half cell may be inserted in a flask containing an indifferent solution and connected with the analysis vessel by a siphon; in this case its end (B) may be closed by agar or by a stopper of cotton or filter paper.

To be introduced directly into the analysis vessel, the bottom end has the form indicated by the dotted trace.

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